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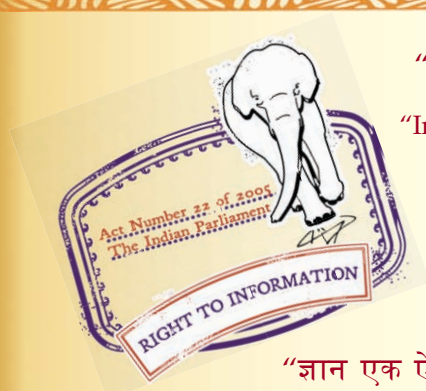
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IS 244 (1984): Method for determination of viscosity (or fluidity) of solutions of cotton and regenerated cellulosic man-made fibres in cuprammonium hydroxide [TXD 5: Chemical Methods of Test]

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“Knowledge is such a treasure which cannot be stolen”

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IS : 244 - 1984

(Reaffirmed 2006)

Indian Standard

METHOD FOR DETERMINATION OF VISCOSITY (OR FLUIDITY) OF SOLUTIONS OF COTTON AND REGENERATED CELLULOSIC MAN-MADE FIBRES IN CUPRAMMONIUM HYDROXIDE

(Second Revision)

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 RAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard

METHOD FOR DETERMINATION OF VISCOSITY (OR FLUIDITY) OF SOLUTIONS OF COTTON AND REGENERATED CELLULOSIC MAN-MADE FIBRES IN CUPRAMMONIUM HYDROXIDE

(Second Revision)

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Indian Standard

METHOD FOR DETERMINATION OF VISCOSITY (OR FLUIDITY) OF SOLUTIONS OF COTTON AND REGENERATED CELLULOSIC MAN-MADE FIBRES IN CUPRAMMONIUM HYDROXIDE

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 27 April 1984, after the draft finalized by the Chemical Methods of Test Sectional Committee had been approved by the Textile Division Council.

0.2 This standard was first published in 1951 and revised in 1969. This has now been revised again with a view to include regenerated cellulosic man-made fibres that is cellulose acetate and triacetate, and mixtures of cellulosic fibres. Changes have been made for calculation of test results, removal of non fibrous materials, mass and moisture regains of test specimens.

0.3 Viscosity of solutions of cellulose in cuprammonium hydroxide is of proved importance in some major industries. For instance, viscosity of such solutions affords a means of control of bleaching and other chemical operations to which cellulose textiles, such as cotton, linen and rayon, are put through. Manufacturers of cellulose, paper, pulp, explosives, celluloids and lacquers also use this characteristic of cellulose solutions in the control of manufacturing processes.

0.4 Viscosity of solutions of cotton and regenerated cellulose in cuprammonium hydroxide has a close correlation with the tensile strength of the fibres. For instance, very large changes at the high end of the viscosity scales are accompanied by changes in the tensile strength of the cotton and rayon fibres which are too small to be capable of direct experimental detection. The absolute viscosity of a solution of a slightly scoured cotton, containing 0.5 g of cellulose per 100 ml, is about 1 poise. But more vigorous scouring treatment may reduce this to 0.2 poise without seriously affecting the quality of the material. A further fall of viscosity from 0.2 to 0.05 poise is accompanied, however, by a loss of 20 to 30 percent in

tensile strength. Changes in viscosity of the same order but at different parts of the scale have, therefore, a different technical significance; this is best brought out when the rate of flow is expressed in terms of fluidity. It has been shown that, when fluidity is plotted against the percentage loss of strength produced by chemical action on cotton, a curve is obtained which approximates more closely to a straight line than that given by other methods of expression.

0.5 While testing mixtures of cellulosic fibres, it is more appropriate to estimate the fluidity of the cotton component only and therefore, only methods for determination of the fluidity of the cotton component are given. Since the majority of the mixtures are prepared before any treatment is applied which is likely to affect the fluidity, it can be assumed that any increase in fluidity of cotton component reflects an increase in the fluidity of the other component, although these changes may not be proportional.

0.6 Three basic methods for calculating test specimen size and test results are given, the first dealing with pure fibre, the second and the third dealing with mixtures of cotton with cellulosic man-made fibres.

0.7 Difficulties in working with such cuprammonium solutions are many. Firstly, it is necessary to exclude air from any lengthy contact with the solutions, as oxygen causes a marked decrease in viscosity. Hence, the solutions are made in the viscometer itself. Secondly, sometime even carefully purified cotton (of consequent high viscosity) and some commercially bleached cotton yarns or cloth give turbid solutions. This is avoided if the nitrous acid content of the solutions is kept below 0.5 g/l and also if the cotton is freed from extraneous matter before being dissolved. Thirdly, solutions of cotton in cuprammonium differ from truly viscous liquids. The apparent fluidity of such solutions consequently varies with the nature and dimensions of the viscometer. This abnormality, which applies particularly to cotton of high viscosity or low fluidity (that is, normal cotton) and which rapidly becomes less accentuated as the severity of treatment of cotton is increased, may be neglected.

0.8 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard prescribes a method for determination of viscosity (or fluidity) of solutions of cotton, regenerated cellulosic fibres and blends of cotton with regenerated cellulosic fibres in cuprammonium hydroxide.

*Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Fluidity — It is reciprocal of viscosity of the solution and is expressed in reciprocal poises.

2.1.1 Fluidity of Cotton — Fluidity of cuprammonium hydroxide solution containing 0.5 g of bone-dry cotton per 100 ml of solution at 20°C.

2.1.2 Fluidity of Regenerated Cellulose — The fluidity of cuprammonium hydroxide solution containing 2.0 g of bone-dry regenerated cellulose per 100 ml of solution at 20°C.

2.1.3 Fluidity of Cellulose Acetate or Triacetate — The fluidity of cuprammonium hydroxide solution containing cellulose acetate or triacetate equivalent to 2.0 g of regenerated cellulose per 100 ml of the solution at 20°C (see Appendix D).

3. PRINCIPLE

3.1 A weighed sample of the material is dissolved in cuprammonium hydroxide solution in a viscometer. The temperature of viscometer and its contents is brought to 20°C in the thermostat. The solution is allowed to flow from the viscometer through the capillary, the time taken by meniscus to fall from one fixed mark to another is noted and then the fluidity is calculated.

4. APPARATUS

4.1 Viscometer — The viscometer shall be as shown in Fig. 1. Glass tube *A* has an internal diameter of 10 mm. The capillary *F* with an internal diameter of 0.88 mm and an external diameter of 6 mm is 25 mm long. Three marks *B*, *D* and *C* are etched around the outer surface of the tube *A* at vertical heights of 242 mm, 122 mm and 62 mm from the flat end of the capillary *F*. The upper end of the tube is closed with a rubber stopper, carrying a capillary tube *E* (the dimensions of the capillary tube *E* are not important). The lower end of rubber stopper should not protrude below the mark near the top of the viscometer. The overall lengths of the viscometer without fittings shall be 300 mm.

NOTE — Tolerances for various dimensions are indicated in Fig. 1.

4.2 Glass Jackets — For supporting the viscometer in the thermostat during the time required to bring the temperature to 20°C and during the time the flow of solution is being measured, a glass jacket shall be provided. One typical glass jacket is shown in Fig. 2; jackets of other designs may also be used provided the viscometer remains vertical in it.

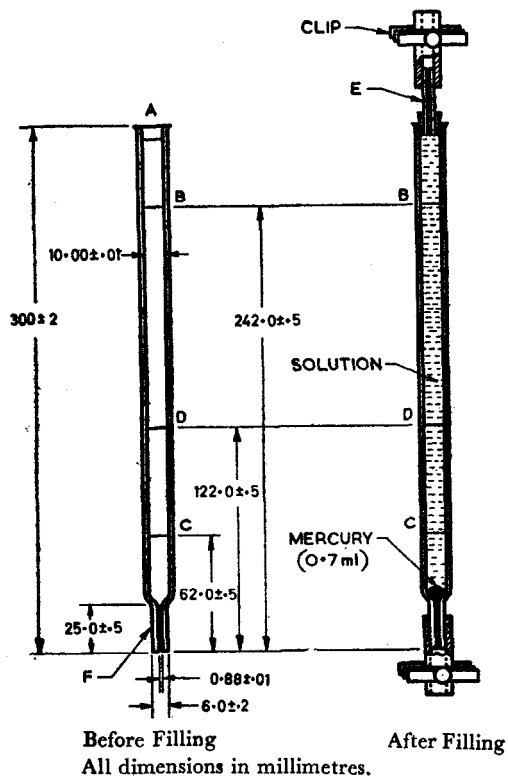


FIG. 1 VISCOMETER BEFORE AND AFTER FILLING THE SOLUTION

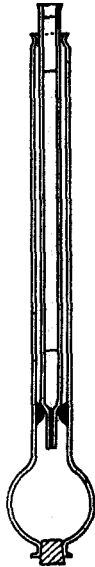


FIG. 2 VISCOMETER IN JACKET READY FOR TIME FLOW MEASUREMENT

4.3 Brass Supports — with plumb line or other means of verifying that the jacket is vertical while the time of flow is being measured. One suitable design is illustrated in Fig. 3.

4.4 Blackened Glass Container — for cuprammonium hydroxide solution.

4.5 A device for rotating the filled viscometer end-over-end at a speed not more than 4 rev/min.

4.6 Glass Thermostat — with stirrer, capable of being maintained at $20 \pm 1.0^{\circ}\text{C}$ or $20 \pm 0.1^{\circ}\text{C}$ (see 6.5).

4.7 Stop-Watch — graduated in seconds and fifth of a second.

4.8 Steel Rod — approximately 1.6 mm in diameter and 300 mm long.

4.9 Strips of Black Cloth — to cover viscometer.

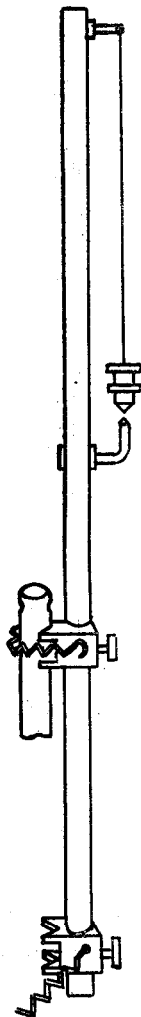


FIG. 3 BRASS SUPPORTS

5. CUPRAMMONIUM HYDROXIDE SOLUTION

5.1 The cuprammonium hydroxide solution used shall have the following composition*.

*Shirley cuprammonium may be used which is available from BDH Ltd, Poole, Dorset.

Copper	15 ± 0.1 g/l
Ammonia	200 ± 5 g/l
Nitrous acid	less than 0.5 g/l

5.1.1 The solution shall be prepared and tested before use as given in Appendix B.

6. PROCEDURE

6.1 Remove all the non-cellulosic matter from the material under examination as given in IS : 9068-1979* (*see Note*) and dry. If a blend is to be tested, determine the composition using the appropriate method as given in IS : 1564-1962† IS : 1889 (Parts 1 and 2)-1976‡ and IS : 2176-1962§ before determining the fluidity using a fresh sample. Condition the sample in standard atmosphere at $27 \pm 2^\circ\text{C}$ temperature and 65 ± 2 percent relative humidity (*see also* IS : 6359-1971||). Cut yarns or loose fibres into lengths of 2 mm such that specimen includes both warp and weft yarns.

NOTE — Some of the methods specified in IS : 9068-1979* may degrade cellulose and therefore, correct fluidity values cannot be obtained when these methods are used to remove added matter.

6.2 **Mass of Specimen** — Calculate the mass of the specimen of cotton or regenerated cellulose required, by the formula given in C-3.

6.2.1 **Cotton** — Assuming the moisture regain of 6.5 percent of pure or slightly modified cotton, weigh to the nearest milligram the required quantity of material as obtained in 6.1 depending on the volume of the viscometer used (*see Appendix C*) to give, on bone-dry basis, 0.500 ± 0.001 percent solution. In case of mercerised cotton, weigh the required quantity of material as in 6.1 assuming moisture regain of 8.5 percent to give 0.500 ± 0.001 percent solution on bone-dry basis depending on volume of the viscometer used (*see Appendix C*).

6.2.2 *Regenerated Cellulose or Cellulosic Man-made Fibres*

6.2.2.1 Weigh the required quantity of regenerated cellulose material as obtained in 6.1, depending on volume of viscometer used, (*see Appendix C*) to give a 2.000 ± 0.001 percent solution on bone-dry basis assuming its moisture regain to be 11 percent. To calculate the mass of acetate or triacetate required *see Appendix D*.

*Recommended methods for removal of non-fibrous matter prior to quantitative analysis of fibre mixture.

†Method for quantitative chemical analysis of binary mixtures of cellulose triacetate and certain other fibres.

‡Method for quantitative chemical analysis of binary mixtures of regenerated cellulose fibres and cotton.

§Method for quantitative chemical analysis of binary mixtures of secondary cellulose acetate and certain other fibres.

||Method for conditioning of textiles.

6.2.3 Mixture of Cotton with Cellulosic Man-made Fibre

6.2.3.1 Method 1 — Find out the concentration of the mixture required on bone-dry basis from Table 1 given below. This concentration chosen gives simple proportionality between the fluidity of the mixture and that of the cotton component.

TABLE 1 CONCENTRATION OF MIXTURE REQUIRED

COTTON IN MIXTURE*	CONCENTRATION 100 (BONE-DRY MIXTURE REQUIRED)
Percent	g/ml OF CUPRAMMONIUM SOLUTION
80	0.762
75	0.807
66.7	0.875
60	0.948
50	1.088
40	1.267
33.3	1.424
25	1.649

*Bone-dry basis.

6.2.3.2 Method 2 — Calculate the concentration of mixture by using the formula:

$$C_m = \frac{1}{1.5R_c + 0.5}$$

where

C_m = concentration of the bone-dry mixture, g/100 ml of the solution; and

R_c = the mass (g) of cotton per g of bone-dry mixture.

NOTE — The second method gives a concentration which equals that which would have been obtained if the components had been separate, the whole of the cotton dissolved at a concentration of 0.5 percent, the whole of the cellulosic man-made fibre being dissolved at a concentration of 2 percent, and the two solutions then mixed.

6.2.3.3 The mass M of bone-dry mixture to be taken for test is given by:

$$M = \left(\frac{C_m V_o}{100} \right)$$

where

C_m = concentration (g/100 ml) from Table 1 or as calculated by above formula (see 6.2.3.2); and

V_o = volume (ml) of the viscometer, as determined in Appendix C.

6.3 Close capillary F of the viscometer (see Fig. 1) with a short piece of pressure tubing and fill the apparatus to half of its capacity with cuprammonium solution. Run a few drops of the solution through capillary F

to ensure that the solvent completely fills the capillary and pour 0.7 ml dry mercury into the viscometer. Add the weighed material (see 6.2.1, 6.2.2 and 6.2.3) in the viscometer and stir the solution rapidly with the steel rod. Fill the viscometer completely with cuprammonium hydroxide solution, insert the stopper so that the excess liquid overflows through the top capillary tube displacing all the air and close it immediately.

6.4 Wrap the viscometer in black cloth and fix it to rotating device. Rotate at such a speed that the mercury moves from end to end during half a revolution, till complete solution of the material is effected (see also Appendix E).

NOTE—A maximum rate of 4 rev/min is suitable even for very viscous solutions. The agitation thus produced is sufficient to cause complete solution of the cellulose overnight.

6.5 Remove the lower clip and the rubber tube off the viscometer and suspend it in a wider tube, and place the assembly in a thermostat maintained for technical determinations, at $20 \pm 1^\circ\text{C}$ and for accurate determination at $20 \pm 0.1^\circ\text{C}$ and till temperature equilibrium is established. Now transfer the viscometer to glass jacket (see Fig. 2), rest it on three glass points at the lower end, and fix it vertically in the thermostat. Open the upper clip so that the solution flows out through the lower capillary. Observe the time necessary for the meniscus to fall from mark B to D and B to C respectively. The time of flow from B to C is only required to calculate the fluidity, the reading from B to D serves to detect any considerable irregularity which might be there due to partial chocking of the capillary.

NOTE—If the flow time of the solution of cellulose in cuprammonium solution is measured at room temperature instead at 20°C , the fluidity determined at that temperature may be converted to that at 20°C by the following formula:

$$F_{20} = \frac{F_t}{0.4 + 0.03t}$$

where

F_{20} = fluidity at 20°C ,

F_t = fluidity determined at $t^\circ\text{C}$, and

t = temperature at which the flow time is measured.

7. CALCULATIONS

7.1 Calculate the fluidity of cotton and regenerated cellulose solutions by the following formula:

$$F = \frac{C_1}{t - \frac{K}{t}}$$

where

F = fluidity in absolute units that is in reciprocal poises,

C_1 = modified constant of the viscometer (see A-1.3),

t = observed time of flow of solution from mark B to C in seconds, and

K = kinetic energy correction constant (see A-1.2).

NOTE — $\frac{K}{t}$ shall be neglected in cases where t exceeds 200 seconds.

7.2 Calculate the fluidity F_m of the mixture by the formula given in 7.1. Then calculate the fluidity F_c of cotton component by the formulae:

$$F_c = 1.4 F_m \text{ (for Method 1 in 6.2.3.1)}$$

or by the formula:

$$F_c = 1.15 \times F_m - 2.2 \text{ (for Method 2 in 6.2.3.2)}$$

8. REPORT

8.0 The report shall state the following:

- a) Fluidity of cotton,
- b) Fluidity of cellulosic man-made fibre,
- c) For mixtures:
 - i) Composition of the blend,
 - ii) The fluidity of the mixture, and
 - iii) The fluidity of cotton.

APPENDIX A

(Clause 7.1)

CONSTANT C AND KINETIC ENERGY CORRECTION FACTOR K

A.1. DETERMINATION OF CONSTANT C OF THE VISCOMETER AND KINETIC ENERGY CORRECTION FACTOR K

A-1.1 Use any of the following as standard for fluidity:

- a) Prepare a mixture of glycerine and water, containing approximately 65 percent of glycerine by weight and adjust the specific

gravity of the solution to 1.168 l in air at 20°C. The fluidity of this solution at 20°C is 6.83 reciprocal poises. The kinematic fluidity of this solution is approximately 8 s/cm² at 20°C.

- b) Use pure phenyl ethyl alcohol (relative density 1.019 and fluidity 7.01) the kinematic fluidity of this chemical is 7.14 s/cm² at 20°C.

A-1.1.1 Fill the viscometer tube with either solution (a) or (b) and allow the liquid to acquire a temperature of 20°C. Observe the time in seconds taken for the meniscus to fall from the upper to the lower etched mark that is from the mark *B* to the mark *C* (see Fig. 1).

A-1.2 If the calibrating liquid is glycerine, calculate the kinetic energy constant *K* as follows:

$$K = 0.131 \times V \times t_g$$

where

V = volume (ml) between the top and bottom timing marks *B* and *C* (see Fig. 1), and

t_g = time of flow in seconds of glycerine solution.

If the calibrating liquid is phenyl ethyl alcohol then:

$$K = 0.117 \times V \times t_p$$

where

V = volume (ml) between the top and bottom timing marks *B* and *C* (see Fig. 1), and

t_p = time of flow in seconds of phenyl ethyl alcohol.

NOTE — The value of *K* should be preferably between 400 to 500.

A-1.3 Calculate the constant *C* of the viscometer by using the following formula:

$$C = 1.075 \times d \times F \times t$$

where

d = density of glycerine solution or pure phenyl ethyl alcohol,

F = fluidity in absolute units of glycerine solution or pure phenyl ethyl alcohol, and

t = time of flow in seconds.

For the determination of cuprammonium fluidity, *C* needs modification. The modified value (*C₁*) is given as follows:

$$C_1 = \frac{C}{d_0}$$

where

d_c = density of cuprammonium hydroxide solution.

NOTE 1 — The density of the cuprammonium solvent and of dilute solutions of cellulose in cuprammonium is assumed to be 0.94 g/cm³.

NOTE 2 — The constant C for the viscometer shall preferably be between 1 750 and 2 100 as determined in A-1.3.

APPENDIX B

(Clause 5.1.1)

PREPARATION AND TEST OF CUPRAMMONIUM SOLUTION

B-1. PREPARATION

B-1.1 Take a suitable bottle of 5 litre capacity, fitted with a cork, carrying a centrifugal stirrer and air-inlet iron tube. The other end of the iron tube is connected to the wash bottle, containing a solution of ammonia (0.88 sp gr). Place 2.6 litres of liquor ammonia (0.88 sp gr), 0.4 litre of water, 3 g of cane sugar and 180 g of precipitated reduced copper (passing through 250-micron IS Sieve*) in the reaction bottle, well-lagged externally with felt, keeping the space between the bottom and the vessel filled with ice to prevent loss of ammonia and excessive formation of nitrous acid. Rotate the stirrer at a speed of approximately 400 rev/min.

B-1.2 Blow air through the wash-bottle into the reaction bottle at the rate of 10 l/h. Compare colorimetrically the solution with a standard solution containing 15 g/l of copper. When the comparison shows that the concentration of copper in the solution under preparation exceeds that of the standard (which is reached usually in about 5 or 6 hours of aeration), allow the solution to settle for 30 minutes, and syphon off the clear liquid into a stoppered bottle. Again allow the solution to settle and syphon off. Analyse the clear liquid for copper and ammonia, and adjust the concentration of copper to 15 ± 0.1 g/l of copper and to 200 ± 5 g/l of ammonia. Check the nitrous acid by analysis (see B-2) and reject the solution if the value obtained exceeds 0.5 g/l.

B-1.3 The cuprammonium solution shall be stored in a blackened bottle fitted with a tap at the bottom and connected at the top through a vessel containing alkaline pyrogallol to a glass vessel (such as a Kipp's apparatus) filled with nitrogen. Keep it preferably at temperatures below 10°C, the stability of the solution being greater at such temperatures.

*IS: 460 (Part 1)-1978 Specification for test Sieves: Part 1 Wire cloth test Sieves (second revision).

B-2. ANALYSIS OF CUPRAMMONIUM SOLUTION

B-2.1 Copper Content — Boil off the ammonia from 25 ml of cuprammonium solution, acidify with nitric acid (1 : 1) and boil again. Remove all nitrous acid by adding a trace of bromine and re-boiling. Cool and then add ammonia solution dropwise until blue colour is formed. Then add 10 ml glacial acetic acid followed by 3 to 5 g of potassium iodide and titrate in the usual way the liberated iodine against standard sodium thiosulphate solution. Calculate the copper content from the volume of standard sodium thiosulphate solution consumed.

[Copper content, g/l = ml of 0.1N Sodium thiosulphate $\times$ 0.254 4]

B-2.2 Ammonia — Add 2 ml of cuprammonium solution to 25 ml of 2 N sulphuric acid, and titrate the excess acid with normal sodium hydroxide, using methyl red as indicator. Run a blank, using the same reagents except cuprammonium solution. Calculate the ammonia content from the difference between the readings for the blank and the solution under test. Correct the value so obtained by subtracting from it the ammonia equivalent to copper which is $0.536 \times C$ g/l of ammonia, C being the copper concentration (g/l).

Ammonia content, g/l = [1 N sodium hydroxide (ml) for blank — 1 N sodium hydroxide (ml) for sample] $\times$ 8.5 — $0.536 \times C$.

B-2.3 Nitrous Acid — Determine the volume of cuprammonium solution necessary to decolorize 10 ml of 0.1 N potassium permanganate in the presence of excess of dilute sulphuric acid at 50°C and calculate the nitrite in the usual way.

Nitrous acid content g/l = $23.51 \div$ cuprammonium solution (ml) required to decolorize 10 ml of 0.1 N potassium permanganate.

APPENDIX C

(Clauses 6.2, 6.2.1, 6.2.2.1 and 6.2.3.3)

MEASUREMENT OF THE TOTAL VOLUME ENCLOSED BY THE VISCOMETER

C-1. The total volume (ml) enclosed by the viscometer is used in calculating the mass of cellulose necessary to obtain a solution of the desired concentration.

C-2. Weigh the viscometer, first empty, and then filled with water as it would be the cuprammonium solution for use. The volume determined in

this way is diminished by 0.7 ml of volume of the mercury stirrer to calculate the total volume of cuprammonium solution to be used in viscometer.

C-3. The mass of the specimen of cotton or regenerated cellulose required can be calculated by the following formula:

$$m = \frac{0.94 \times V \times C}{100 - M}$$

where

m = mass of the specimen required,

V = volume of liquid in the dissolving tube,

M = moisture content of the specimen,

C = percentage of the solution of cotton or regenerated cellulose required, and

0.94 = density of cuprammonium hydroxide solution.

APPENDIX D

(*Clauses 2.1.3 and 6.2.2.1*)

CALCULATION OF THE REQUIRED MASS OF ACETATE OR TRIACETATE FIBRE

D-1. Calculate the required mass of acetate or triacetate by the following formula:

$$M = 2V_o \left(\frac{1}{100 - m} \times \frac{142.9}{142.9 - A} \right)$$

where

M = required mass of acetate or triacetate (mg),

V_o = total volume of viscometer as determined in Appendix C,

m = percentage of moisture (water, g/ 100 g of bone-dry cellulose acetate), and

A = percentage acetic acid yield of acetate or triacetate.

APPENDIX E

(Clause 6.4)

PRE-TREATMENT OF FIBRES WHICH ARE DIFFICULT TO DISSOLVE

E-1. Natural cotton, very mildly scoured cotton, mineral dyed or chrome proofed cotton, cotton dyed with sulphur black and certain reactive dyes require a pre-treatment for complete dissolution in cuprammonium solution.

E-1.1 Boil for 1 hour under reflux in 1 percent sodium hydroxide solution in case of grey cotton and cotton dyed with sulphur black before conditioning and testing.

E-2. Boil for 2 hours in 4 percent sodium carbonate solution in case of cotton dyed with some reactive dyes, for example those based on dichlorotriazine.

E-3. In case of mineral dyed or chrome proofed fabrics, or fabrics treated with aminoformaldehyde resins, the results are of limited value because of the hydrolytic action of the acid used on cellulose. Better fluidity value can be obtained by subtracting the fluidity value of a similarly treated control sample from that of the sample under examination. But this is only partially satisfactory because the resin or mineral dyeing may exert some protective action on the cellulose.

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IS:

- 199-1973 Methods for estimation of moisture, total size or finish, ash and fatty matter in grey and finished cotton textile materials (*second revision*)
- 200-1969 Method for determination of copper number of cotton textile materials (*first revision*)
- 389-1973 Method for estimation of small quantities of sulphuric acid and hydrochloric acid in cotton material (*first revision*)
- 647-1965 Methods for determining the designing efficiency and the relative efficiency of amylolytic enzymes (*revised*)
- 1383-1977 Methods for determination of scouring loss in grey and finished cotton textile materials (*first revision*)
- 3522 (Part 1)-1966 Methods for estimation of common preservatives used in textile industry, Part 1
- 3522 (Part 2)-1970 Methods for estimation of common preservatives used in textile industry, Part 2
- 3522 (Part 3)-1983 Methods for estimation of common preservatives used in textile industry, Part 3
- 4202-1967 Method for determination of chloride content of textile materials
- 4203-1967 Method for determination of sulphate content in textile materials
- 4420-1967 Methods for determination of conductivity of aqueous and organic extracts of textile materials
- 4655-1968 Method for determination of iron and chromium in textiles
- 5151-1969 Method for evaluating the relative efficiency of wetting agents for mercerization
- 5152-1969 Method for estimation of benzene-methyl alcohol-soluble matter in textile materials
- 5449 1969 Methods for determination of water soluble chromate in textile materials
- 7044-1975 Method for determination of sodium chlorite content in textile materials
- 7045-1973 Method for determination of hydrogen peroxide content in textile materials
- 8476-1977 Method for determination of wool content in woollen textile materials
- 8477-1977 Method for determination of bitumen content in laminated jute bags



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